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ABSTRACT

This thesis deals with usability assessment for a mobile-emulator of virtual reality environment for room decorating application in Android platform titled, Virtual Room Decorator (VRD) in Android Application, which is it consists of the overview of proposed project, perception of the planetary surface, techniques will use to create the 2D/3D models and its database restoration. I wish to build a high quality database of room decorating scenes, along with its real-world three dimensional (3D) viewer. Such a database is useful for a variety of applications, including training systems for object detection and validation of 3D output. Also provides a simulation mobile platform to test and validate different rover chassis design, its navigation and locomotion algorithms, and the support rover operation for the application built. Besides, the comparison with the various related current systems and applications in the web browser and usability of popular mobile application platforms also issued here.

ABSTRAK

Tesis ini membentangkan mengenai penyelidikan dalam kemudah-gunaan persekitaran realiti maya untuk projek aplikasi mengrias ruang rumah bertajuk, Rias Ruang Maya atau Virtual Room Decorator (VRD), menggunakan emulator telefon bimbit dengan platform Android. Ianya terdiri daripada gambaran dan rumusan keseluruhan projek yang dicadangkan, persepsi permukaan model landasan dalam aplikasi, teknik-teknik yang digunakan untuk mewujudkan model-model 2D atau 3D, dan penyimpanan pangkalan data model-model tersebut. Saya ingin membina sebuah pangkalan data ruang rias yang berkualiti dengan sudut pandang dunia sebenar tiga dimensi (3D). Pangkalan data ini berkemungkinan berguna untuk pelbagai aplikasi lain, termasuk sistem latihan untuk mengesan objek dan pengesahan output 3D. Tesis ini juga menunjukkan kepelbagaian beza reka bentuk 'casis rover' (kerangka sudut pandang pengguna primier) yang diuji dan dipastikan (pengesah-jayaan) menggunakan platform simulasi mudah alih Android, navigasi dan algoritma pergerakannya, dan penyokong operasi 'rover' yang diguna dalam aplikasi yang dibina. Selain itu, juga diisukan perbandingan kepelbagaian sistem semasa yang sedia ada dan aplikasi-aplikasi yang berkaitan dalam laman-laman web yang mempunyai fungsi aplikasi yang hampir sama, serta kebolehgunaan aplikasi ini dalam platform-platform telefon bimbit yang lain.

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CHAPTER 1

INTRODUCTION

1.1 BACKGROUND OF STUDY

It seems that every few years, people all over the world are increasingly using 3D technology in their daily life. Much, but not all, relate to navigation in virtual environments, while other research relates to the inclusion of use of depth/perspective. Refer to the Wikipedia description, 3D computer graphics (in contrast to 2D computer graphics) are graphics that use a three-dimensional representation of geometric data (often Cartesian) that is stored in the computer for the purposes of performing calculations and rendering 2D images. Such images may be stored for viewing later or displayed in real-time.

In 3D computer graphics, 3D modeling (also known as meshing) is the process of developing a mathematical representation of any three-dimensional surface of object (either inanimate or living) via specialized software. The product is called a 3D model. It can be displayed as a two-dimensional (2D) image through a process called 3D rendering or used in a computer simulation of physical phenomena. The model can also be physically created using 3D printing devices.

Any of 2D or 3D technologies play their roles better in their own fields. 2D is a way better in information visualization and mining, such as to deal with categorical, discrete variables, and sparse sampling of real world for the example. 2D technologies commonly

were focused on discovery of patterns, trends, clusters, outliers, gaps, etc. while 3D is better in scientific visualization especially when dealing with continuous variables, and dense sampling of real world. Usually 3D technologies were focused on vision impression, such as photography, digital art, etc. 3D also a way better in first-person experience because of it used to focus on simulation of real world. For the preliminary conclusion, even 2D is easier to draw or make, 3D gives a better graphics of visualization.

Figure 1(a): 2D room design

Figure 1(b): 3D room design

Mobile phone is considered as an essential part of today's moderm life. For some people, they cannot even last an hour without their mobile phone. Application such as reminder calendar and alarm clock is so common in today's mobile phone; practically all of moderm mobile phone contains such application. Besides that, it is common for a mobile phone to allow the user to download new application which greatly enhanced its functionality beyond mere calling and personal organizing.

Low-end mobile phones are often referred to as feature phones, whereas high-end mobile phones that offer more advanced computing ability are referred as Smartphone. A Smartphone is a mobile phone that offers more advanced computing ability and connectivity than a contemporary basic feature phone. Smartphone and feature phones may be thought as handheld computers integrated within a mobile telephone, but while most

feature phones are able to run application based on platforms such as Java ME, a Smartphone allows the user to install and run more advanced application based on a specific platform. Smartphone run complete operating system software providing a platform for application developers.

So here, I am going to propose a project titled 'Virtual Room Decorator' in Android application. It is the 'virtual accessories' or application that can be used in the mobile phones, especially using Android platform to decorating a room. Regarding to the title, Virtual Room Decorator (VRD) in Android App, virtual here used by extension to the original philosophical definition, the term virtual has also come to mean "modeling through the use of a computer", where the computer models a physical equivalent (see Wikipedia description). Thus, a virtual world models the real world with 3D structures and virtual reality seeks to model reality, enhancing a virtual world with mechanisms for eye and hand movements. Virtual reality (VR), also known as virtuality, is a term that applies to computer-simulated environments that can simulate physical presence in places in the real world, as well as in imaginary worlds.

Although conventional 2D GIS plays important role in the cultural heritage custody, its abilities seems today as overcome. A lot of information on cultural heritage has the third dimension and it turned out that a 3D GIS can bring additional functionality (for example when coupled with furniture registers). There is also other aspect of 3D information – today's great popularity of 3D models that applies to models of cultural heritage also. Such 3D models are created either for documentation purposes or for an attractive visualization of the part of cultural heritage.

My project aims at creating a design data model focused on the areal of furniture. The data model implemented in X3D data file may afterwards be integrated into an HTML webpage using X3DOM. X3DOM uses X3D data embedded in (X)HTML pages and optional X3D-XML files referenced by the embedded part. The X3D-XML files can reference further X3D-XML files and therefore build a hierarchy of asset containers. So the step taken was to embed the X3D file by hand in a (X)HTML page, but this may include

some hand-tweaking, which solute by using the aopt-converter described in Generic 3D data conversion.

Regarding to the title then, Android was referred to a software stack for mobile devices that includes an operating system, middleware and key applications. The Android SDK provides the tools and APIs necessary to begin developing applications on the Android platform using the Java programming language. The definition of App is an abbreviation for application. An app is a piece of software. It can run on the Internet, on computer, phones or other electronic device.

For examples, Google refers to their online services as apps, but they also sell a specific suite of services known as Google Apps and have an application hosting service called Google App Engine. Also, we can download iPhone apps from Apple App Store. It just same goes to Android apps that will be used in the propose project, where we get the several of applications from the Android Market. For free applications, we don't have to worry about entering a password every time trying to install anything. The best part is, we do not have to link to Apple's iTunes store to purchase applications from the Android Market. For those apps that have a price, we just need to enter our information on the Google Market one time and we're done.

About the Virtual Room Decorator or VRD, it is the 'virtual accessories' or application that can be used in the mobile phones, especially the smartphone, which is using Android platform to decorating a room. The current practice when someone wants to do room decoration activity is the user need to install the application from the Android Market and then using the application by clicking the categories on the phone screen to see the options with a simple swipe of a finger. The service that will provide in the VRD application includes selecting the room space and its style option. Then from the options, user will have fun changing the flooring, the wall colors, the ceiling types and colors, the cabinetry/furniture and more.

Seem like many users were interested in the use of 3D interfaces for navigation and orientation in a virtual environment. The virtual environment contained the objects that one would normally have on their computer desktop, for the example of files, applications etc. That is the point of VRD in Android Apps was proposed, which is providing a more reliable, flexible and easier platform of decorating a room for users, without wasting their time and money hiring an interior designer, as easy as do it on their own phones.

As technology and software keeps advancing the sophistication in 3D virtual room planning tools continues to grow. VRD in Android Apps will help user find an offline design tool that works best for users in decorating their room. As the suggestion, the application to be done is free with so users can start designing their own room immediately and in 3D visualization anywhere and anytime. This proposed application also will give the user a good idea about where they would like to take their designing and decorating ideas.

By developing this application also, it can upgrading or may be replaces the current programs. This project is proposed to improve user experience when using virtual room decorator with the whole process to be more easy to use and friendly with users need to cover up the problems. It's as easy as simply loading up the designer and start decorating the room by drag and drop. This application will saves cash, time, labor and a whole lot more. This is pretty self-explanatory. If users know exactly what they are getting and can see on a screen what their home will finally look like, planning is a lot easier.

1.2 PROBLEM STATEMENT

There are still many outstanding issues in the use of 3D in user interfaces; some of which are: use/interaction (input, output), effects on workload, and effects on learning. Through of so many of room decorations in the website (desktop browser), the most current web browser won't be able to load up, display and render live 3D models without any downloading and installation of any active X controls or web browser plug-ins. The current

VRD programs held in web browser have a need of installing plug-in for viewing its 3D elements. Plug-in, such as Flash, Java, etc. actually gives a lot of disadvantages to the program mostly the slow rate of loading and requires client site installation, depending to the client operating system (OS) necessity.

Yet, there is no VRD app yet in Android apps. The weakness when using the Android web browser from the desktop web browser is to get the most out of web content, user need to request full desktop versions of web sites for their mobile versions. Most of the limitation using the desktop browser is the need of excellent connectivity to the network.

Users usually familiar with the experience of going to various stores for chips, swatches, and samples for redecorated or remodeled their home space/room. This is usually faced by interior designers. The designers have to determine the client's needs and wishes. The designer usually meets face-to-face with the client to find out how the space will be used and to get an idea of the client's preferences and budget. It’s exhausting, and in the end their clients don’t really get a good picture of what the final results will be.

Therefore, here are the problem statements that can be highlighted in order to develop this project:

i. Viewing 3D elements and virtual environment using plug-in like Flash, Java etc.
ii. The Android web browser can’t get the most out of web content from the desktop web browser, user need to request full desktop versions of web sites for their mobile versions.
iii. Hard to meet the customer’s satisfaction of decorating their room without any ‘imaginary picture’ to refer. It’s really wasting time and money.

1.3 OBJECTIVES

The objectives of the research are:

i. to construct 3D model (that used for VRD app) from the X3D data into Android emulator platform in improving the technical performance in projecting data(3D elements) in web apps without the need of installation of any plug-ins.

ii. to develop a prototype of Virtual Room Decorating standalone application.

1.4 SCOPES OF STUDY

User	Scope
Administrator	System developer will have full control of the application and administrative rights. She/He will be able to update the database on the application.
User	Whoever using the Android devices and using the mobile browser can interact with the application.

Table 1.2(a): Scopes description for target user of the application

System	Scope
System scope	Capture data from client's input to the VRD system
	Clustering data according to the rule provided
	Represent and display model in a meaningful figure

Table 1.2(b): Scopes description for the application system

1.5 OVERVIEW OF THE THESIS

VRD in Android Apps is far reliable, flexible and easier compare than room decoration programs in the website (desktop web browser), when VRD in Android App can brings an entirely new look and different from the other virtual programs. The relevant of bringing this project out is no such application or program (virtual room decorator) using Android platform. So due to less powerful web browsing of Android Browser, VRD in Android Apps offers an experience that's as rich and convenient as a VRD site in desktop browser.

Through of so many of room decorations in the website (desktop browser), what is making the proposed project, VRD in Android Apps differ from others is the ease of developing on the platform. Most of the limitation using the desktop browser is the need of excellent connectivity to the network. Here, VRD in Android Apps comes to lets user instantly jump to the application content faster, and even loading the activities in case there's no network available. It also proposed for easier browsing across the content of the application which is suit for the limitation of phone screen.

Today, designs often are created with the use of computer-aided design (CAD) software, which provides more detail and easier corrections than sketches made by hand. Upon completing the design plan, the designer will present it to the client and make revisions based on the client's input. But the current tools have limited functionality on designing and no walk-thru space viewer. One of the features from the proposed project, VRD in Android Apps, is the camera angle so users can view their room from various vantage points.

VRD also proposed to develop as the innovative point-and-click design tool that allows users to choose the style and type of room (especially living/family rooms) and change the Virtual Room Decorating flooring, ceiling, walls, furniture and cabinetry until the room design is just right. VRD application is the perfect place to unleash user's inner interior designer.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

2.1.1 Background to the study

3D computer graphics (in contrast to 2D computer graphics) are graphics that use a three-dimensional representation of geometric data (often Cartesian) that is stored in the computer for the purposes of performing calculations and rendering 2D images. Such images may be stored for viewing later or displayed in real-time; whereas 2D computer graphics is the computer-based generation of digital images—mostly from two-dimensional models (such as 2D geometric models, text, and digital images) and by techniques specific to them. The word may stand for the branch of computer science that comprises such techniques, or for the models themselves. (*From Wikipedia, the free encyclopedia*)

Interior designers use a variety of analog and digital tools and media to plan and design constructions on their decorations. Immersive virtual reality (VR) technologies have shown great potential for architectural design, especially for exploration and review of design proposals. In this work I propose a virtual home-style application, which allows designers and clients to use arbitrary real-world tools such as maps or rulers during immersive exploration of virtual 3D models in their decorations.

3D-modelling technology acts as the catalyst for interaction and participation among the pairs, and as the medium for ongoing discovery. Architecture students and kids

have the chance to learn and use advanced modeling both on the computer and in the making of physical, computer-cut models that build and reveal unseen space, applying them to an expanded, transcendental vision of their own surroundings. (*Amanda Schachter and Alexander Levi, 2004*)

In our modern day of looking at home improvements shows, surfing architecture and interior design websites, and spending countless hours on planning our spaces we live each day, the client will love to plan them virtually first. It is easy, time-saving and low-cost. The user interface allows designers and clients to review designs and compose 3D architectural scenes, combining benefits of mixed-reality environments with immersive head-mounted display setups.

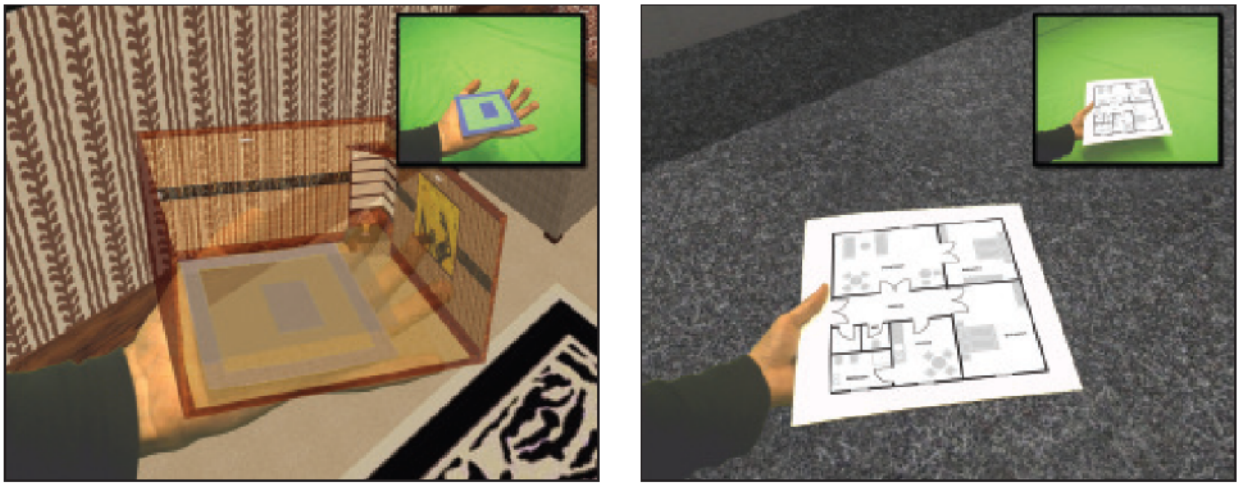
2.1.2 Development and Implementation Techniques

Modern computer-based media have shown to be useful throughout architectural design processes and the life cycle of architectural constructions. In the last stages of the architectural design process, analog as well as digital models give architects and clients a good impression of the final result. In this context, immersive virtual environments (IVEs) have great potential to enhance architectural design. In IVEs users get a natural impression of virtual 3D designs from a realistic point of view via head-tracking, which allows them to turn and move their heads to explore the 3D models.

Visualization and Computer Graphics (VisCG) Research Group (*University of Munster, 2010*) in their research on *Immersive Virtual Studio for Architectural Exploration* had noted that, in head-mounted display (HMD) environments users can explore 3D models at real scale by walking [10] or flying [1] through the virtual space. Recently developed user interfaces based on redirected walking [6] allow users to explore large virtual scenes on foot while walking in the restricted area of a VR laboratory. (*Visualization and Computer Graphics (VisCG) Research Group, 2010*)

With information about the structure of virtual scenes, specifically in the context of architecture, large models can be subdivided in cells of approximately the size of the laboratory room, and explored sequentially using virtual doorways and portals as means for redirection, which ensure that the user does not collide with obstacles in the real world. According to *Noha Saleeb, Georgios Dafoulas* from UK, the emergence of virtual worlds, e.g. 3D virtual learning environments, has enabled testing of computer aided designs of virtual prototypes in these online networked venues where users performing business, social or educational activities etc.can practically employ these building models and evaluate them for virtual use or construction in the "real life" world.

Computer-aided design (CAD), also known as computer-aided design and drafting (CADD), is the use of computer technology for the process of design and design-documentation. Computer Aided Drafting describes the process of drafting with a computer. CADD software, or environments, provides the user with input-tools for the purpose of streamlining design processes; drafting, documentation, and manufacturing processes. CAD may be used to design curves and figures in two-dimensional (2D) space; or curves, surfaces, and solids in three-dimensional (3D) objects. Originally software for Computer-Aided Design systems was developed with computer languages such as Fortran, but with the advancement of object-oriented programming methods this has radically changed. Today, CAD systems exist for all the major platforms (Windows, Linux, UNIX and Mac OS X); some packages even support multiple platforms.



(a) (b)

Figure 2.6: Augmented working environment: (a) hand-held marker used to display a world in miniature 3D model, and (b) user reading a floor plan while being immersed in the virtual model. Insets show the real-world view

The process of creating 3D computer graphics can be sequentially divided into three basic phases: 3D modeling which describes the process of forming the shape of an object, layout and animation which describes the motion and placement of objects within a scene, and 3D rendering which produces an image of an object.

2.1.2.1 3D Modeling (Meshing)

The model describes the process of forming the shape of an object. The two most common sources of 3D models are those originated on the computer by an artist or engineer using some kind of 3D modeling tool, and those scanned into a computer from real-world objects. Models can also be produced procedurally or via physical simulation.

2.1.2.2 Layout and animation

Before objects are rendered, they must be placed (laid out) within a scene. This is what defines the spatial relationships between objects in a scene including location and size. Animation refers to the temporal description of an object, i.e., how it moves and deforms over time. Popular methods include keyframing, inverse kinematics, and motion capture, though many of these techniques are used in conjunction with each other. As with modeling, physical simulation is another way of specifying motion.

2.1.2.2.1 Lighting

Lighting is an important component of the rendering process. It is a technique that used for reveals the 3D world, sets the mood of the scene, and also contributes significantly to the overall processing time necessary to render the scene. The purposes is for artistic storytelling and paramount in the correct exposure of the scene, such as for film, video, and digitally.

2.1.2.2.2 Mapping

Mapping is refers to map-making. In computer graphics, texture mapping is a method for adding detail, surface texture (a bitmap or raster image), or color to a computer-generated graphic or 3D model. A texture map is applied (mapped) to the surface of a shape or polygon.

2.1.2.2.3 Ray Tracing

In computer graphics, ray tracing is a technique for generating an image by tracing the path of light through pixels in an image plane and simulating the effects of its encounters with virtual objects. The technique is capable of